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ABSTRACT

Traditionally, many science educators have taught science without addressing ethical questions. However, the inclusion of moral discourse in science teaching may help educators to bring to the fore problematic issues in relation to science, and it may offer an opportunity for students to practice their future engagement in the public discourse about science. This paper presents the results of a qualitative evaluative case study using several methodological lenses. The focus of the study was on the appropriateness of dilemma stories as a standard tool to initiate critical reflection and moral discourse within the theoretical framework of constructivism, as well as on the multiple perspectives of the students, teachers, and the researcher. The context of the study was a project conducted in a public senior high school in Austria with one biology teacher and one mathematics/physics teacher and their classes. The results indicate that teaching using dilemmas can promote multiple intelligences and can lead to self-examination, to critical assessment of assumptions, and to perspective transformation, all of which form part of transformative learning. On the teachers' side, this type of teaching challenges a teacher's skills with regard to facilitation, moderation, and self-restraint in order not to impose one's opinion on the students. (Author)

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Dilemmas with Dilemmas...

Exploring the suitability of dilemma stories as a way of addressing ethical issues in science education

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Abstract

Traditionally, many science educators have taught science without addressing ethical questions. However, the inclusion of moral discourse in science teaching may help educators to bring to the fore problematic issues in relation to science, and it may offer an opportunity for students to practice their future engagement in the public discourse about science. This paper presents the results of a qualitative evaluative case study using several methodological lenses. The focus of the study was on the appropriateness of dilemma stories as a standard tool to initiate critical reflection and moral discourse within the theoretical framework of constructivism, as well as on the multiple perspectives of the students, teachers, and the researcher. The context of the study was a project conducted in a public senior high school in Austria with one biology teacher and one mathematics/physics teacher and their classes. The results indicate that teaching using dilemmas can promote multiple intelligences and can lead to self-examination, to critical assessment of assumptions, and to perspective transformation, all of which form part of transformative learning. On the teachers' side, this type of teaching challenges a teacher's skills with regard to facilitation, moderation, and self-restraint in order not to impose one's opinion on the students.

Introduction

This paper presents an interpretive case study within the 7th Moment of Qualitative Research (Lincoln, 2000), using several methodological lenses to inquire into the experiences of teachers, students and the researcher during a month-long project called "Ethics in Science", conducted at a co-educational, public senior high-school in Graz, Austria. The research presents aspects of a doctoral thesis that investigated the multiple perspectives of teachers, students and the researcher in relation to the efficacy of teaching ethical issues using a dilemma approach within a critical constructivist framework (Taylor, 1998). In this paper, I focus on the 'dilemmas with dilemmas' – in other words, if we want to use dilemma-stories as a teaching method what do have to take into consideration?

Background of the study

The changing global society has made necessary changes to the education system and thus changes to the national curriculum frameworks of many countries. When Austria joined the European Union on the 1. 1. 1995 new challenges and requirements had to be met by the Austrian schooling system, including issues such as multiculturality and European integration (Bundesministerium fur Bildung, 2000; Kirste, 2001). The result was a revised curriculum framework, the "Lehrplanreform 99" (Curriculum Reform 99) for the lower level of secondary schools (Years 5-8) which is now at the stage of implementation. As with every Middle European curriculum document, the educational goal lies in the provision of 'Allgemeinbildung' (German: ~general education) to every student.

The concept of 'Bildung' forms the philosophical backbone of Middle European educational thought. An important part of 'Bildung' is represented by an analysis of values grounded in the rapid societal change in Europe, in European integration, in globalisation, in intercultural exchange, in democracy, in worldviews, and, last but not least, in an incorporation of moral and ethical values which allows the individual to approach ethical dilemmas in an informed manner. The term 'Bildung' (German = formation) is very difficult to translate into English because there is no direct equivalent. It may tentatively be translated as the 'formation of the whole individual', similar to the concept of 'holistic education' which is a commonly used term in English speaking countries.

In the new curriculum document, the new overarching curriculum statement is geared towards the development of self and of social competencies as well as towards the development of the ability to make informed decisions. The new overarching curriculum statement also focuses on the development of key qualifications, such as team-competency and empathy, communication skills, self-security, organisational talent, the development of persistence, the ability to include other people and to

convince them of common goals (Eichstätt, n.d.). The striving for these competencies is also mirrored in the new 'key features' of the curriculum framework, such as in the analysis of society and of values. In the curriculum document, this key-feature is described as the 'Religious-Ethical-Philosophical Dimension' of 'Bildung'.

When the new curriculum framework was about to be implemented, many Austrian teachers voiced concerns about how they were facing the dilemma of teaching moral issues without appropriate methodologies and pedagogical competency. Given this background, the Austrian Youth Red Cross initiated a study addressing how to improve moral and value education in Austrian classrooms (Gschweitl, 1998). As a member of the research team, I was directly involved in the initial planning, implementation and evaluation stages of the project. The result of the project was a teaching approach adapted to meet the requirements of a constructivist learning environment that was using dilemma stories to initiate moral discourse. The dilemma approach, using dilemma stories, was based on the works of Lawrence Kohlberg (Kohlberg, 1984; Kohlberg, 1996).

Drawing on my experiences during the Red Cross Project, and taking into account insights gained through the study of additional literature on moral education, I subsequently focused my doctoral thesis on the evaluation of dilemma approach based teaching within the context of science education. According to (Allchin, 2001), many science teachers, in other countries also, seem to shy away from addressing values because of fear that values are outside of the domain of science or, in the worst case, that values betray the very core of science. This is also mirrored in the rather small number of publications within science education addressing issues of moral and ethical education.

Research problem

Moral education is often focused around dilemmas. A dilemma is a choice between equally (un)pleasant possibilities. In Frazer and Kornhauser's book

we learn that there are several possibilities of presenting dilemmas: dilemma stories, films, moral biographies (Frazer & Kornhauser, 1986),. However, in the literature on moral education I found that dilemma stories are often suggested as 'the' tool to achieve critical reflection and ethical discourse in a classroom since Kohlberg trialled dilemmas over thirty years ago. According to Kohlberg's theory, the suitability of dilemmas is grounded in the concept of 'values clarification' whereby students explore their own values through critical reflection, and later compare and discuss those values with their peers which (if successful) leads to a cognitive disequilibrium that leads to moral learning.

However, browsing the literature, I found that there seems to be a lack of critical appreciation with regard to the appropriateness and suitability of dilemmas, and dilemma stories in particular, for use in ethical education. Given that many science teachers lament the lack of suitable materials for teaching ethical issues within science education, the question arose for me as to what these materials should look like and what we can expect of the use of dilemma-stories, leading to the following research problem: How suitable are dilemma stories as a pedagogical tool for initiating moral discourse? What are the shortcomings we have to take into consideration if we as curriculum developers develop curriculum materials based on dilemma stories and suggest the use of these dilemma stories to practitioners in the classroom?

Research questions

A research study was designed to address the following research questions:

1. Examine the efficiency of using dilemmas in order to engage students in moral discourse within science teaching.
2. Explore possible topic areas for dilemmas.
3. Examine ways of ensuring the appropriateness of dilemmas for particular groups of students.
4. Investigate teachers' and students' experiences with the use of dilemmas in science education.

5. Explore the skills teachers need in order to use this type of teaching successfully.

Significance

Traditionally, through the influence of scientism, science has been taught as if science could and should be value-free (Allchin, 1998; Allchin, 2001). References with regard to ethical education within science education, apart from papers on bioethics (Iozzi, 1982; Macer, 1994b), are scarce (Degenhart, 1986; Frazer & Kornhauser, 1986; Johnston, 1995; Mattox, 1975; Michael, 1986; Patry, 2000; Poole, 1995; Witz, 1996; Zeidler, 1984, 2002). Addressing ethical issues in science education through dilemmas can be a way of teaching about the nature of science by enabling students to practice participation in the public discourse about science in a critical informed manner and in a "safe" environment. It may contribute not only to scientific literacy but also to the development of social and emotional skills, and of critical reflexivity (Settelmaier, 2002).

Theoretical underpinnings

The use of dilemma stories in the study can be traced back to one of the pioneers of moral development research and moral education (Kohlberg, 1984, 1996), who developed a cognitive-developmental theory of moral development consisting of six stages, based on Piaget's work on moral development (Piaget, 1977). However, Kohlberg's theory became the focus of feminist critique, primarily through the work of Carol Gilligan who criticised Kohlberg's claim that women's "ethic of care" represented a lower stage of morality than men's "morality of justice" (Gilligan, 1982; Gilligan, 1988). Contrary to Kohlberg's dilemmas, which were hypothetical in their nature, Gilligan preferred to draw from participants' lives (Tronto, 1994). Nevertheless, Gilligan's work has also become the target of criticisms by, for example, Tronto (1994) and (Hoff Sommers, 2000).

Towards the end of the study, I discovered the Theory of Transformative Learning to be very useful for understanding the results of the data analysis. This theory was developed by Jack Mezirow, an adult educator, and represents a combination of constructivist thought and the Critical Theory of Jurgen Habermas. Mezirow's theory of transformative learning was originally developed for adult education, however because ultimately ethical education has a transformative intent, I believe that it may be a suitable theory for guiding ethical teaching and learning at any age level. If implemented successfully, this type of education results in transformative learning whereby the learner critically assesses assumptions (beliefs, values, etc.) which may lead to a perspective transformation, and in the case of ethics education, (hopefully) to moral learning.

In the research study, I chose to adopt a critical stance towards the (often uncritically adopted) tool of dilemma stories, thereby focusing on the evaluation of the suitability of the dilemma approach with regard to moral learning. I deliberately did not engage in any type of measurement of moralities of the participants for two reasons: 1) my research within this interpretive study was on understanding, and 2) because I am convinced that "measuring" of others' moralities is judgmental and ultimately incommensurable with taking seriously an Ethic of Care.

Design and procedures

This qualitative case study was designed as a 'bricolage' within the 7th moment of qualitative research drawing from ethnography, phenomenology, feminism and biographical research (e.g., Denzin, 1989; Lincoln, 2000; Moustakas, 1994). The use of multiple methods of data-generation serves the purpose of crystallisation. It was very important to me to maintain the original voices as often as possible in order to establish 'polyvocality'.

The research was performed at a co-educational, public senior high-school in Austria and had three stages: curriculum development, curriculum implementation, and curriculum evaluation. The participants included two

female teachers, a biology teacher and her Year 9 students, and a mathematics/physics teacher and her Year 10 students. Both teachers were subject- as well as class teachers which means, within the Austrian context, that they have a pastoral function allowing them to get to know the children very well. The dilemma approach was based on the approach developed by (Gschweitl, Mattner-Begusch, Neumayr, & Schwetz, 1998) during a project initiated by the Austrian Youth Red Cross. During the "Ethics in Science Project" in 2000, the dilemma stories were co-created by myself, as the researcher, and the two teachers, Irene and Sandra. We tried to fit the stories to the curriculum that would have been taught in any case, in order to reduce potential imposition of 'artificial' topics. Three dilemma stories were evaluated (The Birth Tree, The Rainforest, The Rocket Scientist). During the fieldwork inquiry, I took on the role of a participant-observer. Semi-structured single and group interviews, feedback sessions with the teachers, and video- and audio-recordings enabled me to explore the participants' experiences with the dilemma approach. Students' submitted a portfolio that included notes about their own reflections on the dilemma situations. Analysis of the interview data and portfolio notes was performed using QSR NVivo software. It was supported by video-analysis and field-notes. In order to meet the requirements of research ethics, I sought permission to conduct the research from the education authorities, and had letters of consent signed by the participants and their parents. I reassured participants of their right to withdraw from participation at any time. I also reassured them that their anonymity would be protected.

Findings

The results section of this paper focuses on seven dilemmas with regard to the use of dilemma stories that crystallised during the analysis process. I chose a dilemma approach for the interpretation of the findings because it allows me to hold apparent opposites in a dialectical tension (Slattery, 1995). The dilemmas reflect the multiple perspectives of the teachers, the students, and

the researcher at that time of the fieldwork and at the time of writing the paper. The data were derived from interviews, field-notes, video-analysis, and conversations with participating teachers. Names have been altered to ensure anonymity for the participants. Interview references state the interview code depending on the data source. For example, 'I-M2000' represents interview data (I), the initial of the interviewee (e.g., M), and the year of the interview (2000).

Dilemma 1: (In)appropriateness of stories

During the curriculum development phase, I was in close email contact with the teachers in order to write the 'right' stories suitable for the age-group. I relied heavily on the teachers' knowledge of the kids and on their professional experience. Due to this collaboration, the stories have actually been co-constructed by the teachers and me. The stories were exchanged and altered until both of us were convinced that the story might meet age-requirements, curriculum requirements and the interests of particular classes. In short, teachers' opinions about the viability of a dilemma were crucial during this phase.

However, during the student interviews I discovered that opinions about the stories varied considerably. Daniela, for example, was very positive about the story, "[I liked] *actually everything. First of all, the story itself!*"(I-D2000), and her classmate, Ulli, commented, "*I was thinking this was a really interesting topic because it was about humans and about how humans really are.*"(I-U2000) On the other hand, some students, such as Maria, contended that, "*I liked it if only it had been a different story, something that speaks more to our age group but still fits in well with the curriculum. If the story had been different I would have preferred that!*" (I-M2000).

One might argue that it is to be expected that not every student likes every story, however what really surprised me was the different perception of the stories between teacher and students. I could observe an interesting phenomenon in Irene's class:

Irene considered the first dilemma story (about a garden 'birth tree' that needs to be cut down in favour of a new campervan) to be slightly too simplistic, however, she went ahead and taught the dilemma unit based on that story. In a conversation after the unit she said, *"I was skeptical because I thought because of the simplicity of the story it might be difficult to get the dilemma across. You know, it can't be taken for granted at this age that they still listen to you!"* (I-I-FS2000). However, whilst Irene thought the story was perhaps too simplistic, students had a slightly different opinion. Fatima continued, *"I was really impressed by the story and still am... I even spoke about it at home enthusiastically – something I don't normally do with regard to school"* (I-F2000). Melinda's comment supported Fatima's apparent enthusiasm, *"When we had the first unit on Monday, I was expecting something very different and when we heard the story about the tree, I thought, "Uhmm well", but now in the end, it has turned out quite OK!"* (I-M2000).

The opposite situation occurred during the second dilemma in Irene's class, the Rainforest Dilemma (in which a plant scientist searching for lifesaving medicine introduces life-threatening disease to indigenous inhabitants of a rainforest). The rainforest is Irene's special area of interest and she was very keen on teaching this unit. During the writing phase, she had had concerns about the complexity of the story which we tried to address by simplifying the story-line considerably. However, during the implementation of the dilemma unit, Irene had the impression that everything was working out 'just fine', as her comment during a conversation after the unit indicates, *"I have the impression they dealt with the issues very well this time. They listened carefully which indicates to me…uhm… and which I interpret in a way that the topic was more age-appropriate for them"* (I-FS2000). From the vantage point of the participant-observer, the situation looked slightly different: I formed the impression that students appeared overwhelmed, which I thought was due either to the short period of time between the two units and/or the complexity of the story which might have been too high after all for this particular age-group. During the interviews, my impression was supported

was much harder to understand....and somehow it was clear to me that I could not do it anyway – like go to a foreign country and bring diseases,...." (FIIp18&23) and she added, *"I have learned much more from the first story than from the second"* (FIIp27). Apparently, the second dilemma did not present a dilemma for some students nor was it at an appropriate level of complexity.

Given that the teaching method is based on stories, these findings present us with a profound dilemma for the curriculum planner and teacher. Although there was close collaboration between the teacher and myself with regard to writing the stories, the stories were not experienced as dilemmas by all students. In one case, the teacher considered a story to be too simplistic, whereas it turned out to be at the right level for the students. In another case, the teacher preferred a story that turned out to be too complex for students' understanding. This leaves us with a very profound question for the writer of curriculum materials: how can we ensure that a dilemma story provides a 'real' dilemma for the teacher and the students given that apparently sound knowledge of the students is not sufficient? This is, I believe, an area for further research and will need more attention. One possibility for addressing the issue might be to have the students develop their own dilemma stories.

Dilemma 2: (In)authenticity of 'individual reflection'

I asked students during the interviews whether or not the dilemma stories had forced them to reflect on problematic issues. Ulli replied, *"I was reflecting on the story, what if I had been there, what would I have done?"* (U7p64).
And Daniela replied, *"I reflected on the problem and whether I have had similar problems like that before and then I tried to find a solution that I considered the best."* (I-D2000) These two examples illustrate that critical reflection took place and that it involved rational intelligence in order to solve a problem, as well as emotional intelligence, whereby one tries to put oneself into somebody else's shoes.

However, during classroom observations, I noted that a high number of students were talking to each other while they were supposed to be working individually. Partly, this might have been due to the crammed classroom situation where students could not easily find a private spot. On the other hand, I observed students copying their neighbours work…I asked students to comment on this observation, and Fatima explained that, *"I felt quite nervous in the beginning when we had to write down our own opinion, and I started asking around, "What are you writing?' "* (I-F2000). Paul, on the other hand admitted that, *"…in the beginning, I wasn't really reflecting on the dilemma, I was primarily responding to the questions."* (I-P2000). Whilst Paul was apparently responding to the questions in an automatic manner at first, Julian questioned the authenticity of other students' statements altogether, *"With some people, I was pretty sure that they would not write down what they were really thinking…*[pause] *but I was surprised at what they did write down.* "He added with a grin, *"In a negative as well as in a positive sense!…If someone has an opinion he will bring it in* [to the discussion] *and if he doesn't then he will just write down something anyway!"* (I-J2000)

For Kohlberg the individual reflection process was of greatest importance (and was used for measuring students' morality levels!). Given that Kohlberg placed much value on values clarification and on the individual reflection process, in particular, the above observations and students' comments leave us with the question as to whether or not it makes sense at all to engage the students in a values clarification process? For the teacher the question is especially crucial as the students' written notes can serve an assessment of learning purpose. On the other hand, we have indicators that some students did engage in critical reflection and thus potentially in a learning process. Thus, we are left with the dilemma: should we bother to engage students in individual reflection if their arguments potentially do not reflect authentic statements at all?

Dilemma 3: (A)moral discourse

From the participant-observer's point of view, I formed the impression that the dilemma stories were a good starting point for moral discourse. The following vignette presents a sample of discourse drawn from the first dilemma unit implemented in Irene's class…The dilemma question was: Was it fair towards the tree to cut it down?

> Daniel: *Absolutely not – the tree has accompanied him, has comforted him and so on, and Jack has never done anything in exchange…*
> Amelia: *I think that nobody should take away the life of any living being be it a human or a plant.*
> Imelda: *I do not think that the tree if it knew about what the parents had said before would be mad about Jack cutting it down.*
> Alex: *I think it is better that Jack cut it down himself*
> Daniel: *Yes but what if you have a cat and the cat falls sick and have to put it down – I would not do it myself?*
> Irene (teacher): *Yes but please consider that tree is not an animal – does this make a difference?*
> Hefty discussion and screaming matches follow…
> Susan: *I think that the main difference is feelings – animals just have more feelings than do plants!…*
> Manuel: *I too believe that humans love animals better than plants because they can show love for humans!…They can express feelings.*
> Irene (teacher): *Plants have been shown to express feelings too when listening to Mozart they virtually hugged the loudspeakers so obviously they do react to vibrations and stuff but not as quickly as we do…*

The discussion about whether or not a plant's life is as valuable as a human's or an animal's life involved students in reflecting on our different attitudes towards plants and animals. Different opinions clashed. The above vignette illustrates that dilemma stories can promote moral discourse. During the interviews, many students reported that they enjoyed the dilemma approach because it apparently gave them an opportunity to hear other people's opinions, as well as to learn more about their colleagues. Julian, for example, said, "*I really liked the 'pros and cons'*. (I-Julian, 2000). Daniela stressed that she really "*…liked the discussion round, the ideas and how they came into being and we were all talking to each other and so…!*" (I-Daniela, 2000). Ulli even pointed to the potential learning effect of this type of teaching, "*I believe you can keep things in mind much better* [like this] *than learning everything only theoretically. Through discussing and listening to others it is certain that something is learned much faster than if you only quickly touch an issue during a lesson. If different topics*

were packed into those dilemma stories one could recall much more! Animal protection, for example, ...don't only say, 'Let's protect the animals!'." (I-Ulrike, 2000)

However, some students expressed concerns with regard to the group-processes surrounding the discourse. Paul, for example, said, *"I find that in a group one's opinion often does not come across because opinions get suppressed ... if there is someone there* [in a group] *who has 'more to say'. I think that group leaders often simply push their own opinions through and this does not reflect what individual people are thinking!"* (I-Paul, 2000). It seems that group-processes were a determining factor in how students experienced the discourse phases. For students, this part of the dilemma unit required the practice of social skills and social intelligence in order to participate actively in the discourse. Thus, a problematic issue that surfaced was the restraining impact of peer-pressure. Related to this issues, some students seemed to feel that speaking about their values 'exposed' them to their classmates, in other words made them feel vulnerable. Ulli supported this impression by saying, *"I do not really like to speak about myself in public!...I don't like to speak about what I'm feeling and what I'm thinking."* (I-Ulrike, 2000) Emma who was quite critical about group-discourse in general, suggested that, *"... opinions should be written down anonymously because then people might actually write down their personal opinions* (I-Emma, 2000). This takes us back to the previous dilemma where we were speculating about reasons for inauthenticity of personal statements.

Can it be that some students are likely to deliberately write 'just something' in order to protect themselves from potential peer-criticism and peer-pressure? Under these circumstances, does it make good pedagogical sense to expose them to a moral discourse situation at all? This leads us to the third dilemma about dilemmas: given that we as teachers, have a duty of care towards the students – is it not ultimately incommensurable with an Ethic of Care to 'coerce' students to 'expose' themselves – well meaning as it might be?

Dilemma 4: (In)frequency of dilemma-units

I was somewhat surprised to find widespread agreement amongst the student interviewees that dilemma units should be implemented on a regular basis; however, there were differences of opinion about the desired length and the number of dilemma units during the school year. Maria, for example, stated, *"Every two or three months a unit…yes I do think so,"* and she added, *"So that it is regularly brought back into consciousness for those people who do not think by themselves"* (M5p45-49). Ulli, on the other hand, argued also in favour of dilemma units, though she cautioned, *"Not as long as this was, but perhaps once a month for two hours in the afternoon, perhaps…I would support the idea of doing it regularly one afternoon per month. If it was being done every week, it would not be fun any longer…"* (U27p69-70) Ulli's comment raised the issue of 'saturation with dilemma units'. Her comment seems to imply that in order for teachers to reach their students they should avoid dilemma overload.

Concluding, I can say that including dilemma classes on a regular basis may be worthwhile, but it is important for teachers to be cautious in using them. *"I think it cannot harm [to do this more often]. As long as it is not every week"* (J19p85). Julian's comment illustrates very well the dilemma curriculum developers and teachers face with regard to the frequency of dilemma units, when students seem to say, "Ethics in science – yes please, but not too often!"

Dilemma 5: Teacher skills

Both teachers were quite enthusiastic about their participation in the study and both received a short introduction into the teaching of dilemma units. Neither of them anticipated potential problems with their roles as moderators of class discussion. Students seemed to appreciate that their teachers facilitated rather than instructed. However, both teachers experienced some 'hiccups' with their facilitation roles.

Irene's experiences with regard to teaching the units were largely positive, however she found it difficult not to make value-judgments about students' expressed views, *"I really tried deliberately to ask further questions such*

as, 'Are there any other ideas? What have you found out collaboratively' etc.... and I tried not to make value-judgments such as, 'Good!' I mean as a teacher you're so happy if someone says something that if somebody says something you usually say, 'Good!'...I found myself reflecting after I had made a comment, whether or not this had been a value-statement...I realised that it requires a deliberate effort to maintain an awareness otherwise you're immediately in a judging role!" (I-I-FS2000) Irene's statements problematises the teacher's habit of seemingly evaluating students' comments on the spot. She later added that she found it very difficult to stand back and not correct some of the students' statements and that, despite many years of teaching experience, this type of teaching required her full attention with regard to her facilitiation skills.

In Sandra's class the moderation of the unit(s) worked very well until Sandra experienced problems with a video-recorder. These technical problems apparently caused her to lose part of her self-security:

> *Sandra: I was lost for words several times*
>
> *Lily: When was that?*
>
> *Sandra: When they started up this discussion about organ-donations, this really was too far off the topic for my taste. Although I have to admit it was me who started this discussion...I did not know whether or not to intervene...*(I-FS2000)

Sandra who, from my point of view as an observer, did well with facilitating the unit, virtually stopped moderating at the beginning of the plenary discussion. It was as if she hoped the discussion would unfold by itself. Instead of keeping the discussion going by asking questions, there was no initiative from Sandra. After long moments of deafening silence, she finally told a very personal story which sparked off the discussion and apparently brought Sandra back into her facilitator's role. After this, she continued to moderate discussion without major problems.

My observations and field-notes indicate that both teachers hesitated occasionally to intervene in group-work. Coming from an adult education background, I am used to working with large groups, be it adults or students.

A particular type of attention is needed to notice disturbances in group-situations and to judge when to intervene. Perhaps I automatically expected the teachers to approach the group-work situation as I would have done.

This pointed out to me yet another dilemma for curriculum developers and practitioners of dilemma teaching: despite the enthusiasm teachers may bring to this type of teaching, we may still expect potential problems with regard to facilitation of the group processes. The skills I am thinking of in this regard are primarily skills for collaborative teaching and learning. I believe that teachers can be introduced to this type of teaching and learning as part of their professional development, and that these communication skills might benefit their teaching in general.

Dilemma 6: Problem students

In a conversation after a dilemma unit, Irene admitted to having focused her attention on two potential troublemakers, already expecting misbehaviour from their side, "*...One of the weak points was that I had figured out beforehand who might potentially 'freak out' with this teaching style and I focused my attention on Alois and Alex*" (I-I-FS2000). In class, Alex and Alois did their best, at least at the beginning of the unit, to fulfill our 'expectations'. They did not fully participate during the storytelling phase and/or the individual reflection phase. Alex and Alois frequently disrupted the flow of the unit with unproductive comments and questions that did not pertain to the story and indicated that they did not take the story seriously.

However, during the final whole-class discussion, these students were amongst the best discussants. Whilst Alex contributed many valuable statements, Alois kept the discussion going by making provocative comments that 'set off' the other class-members. It was interesting to see that Alex apparently swapped sides during the discussion and became one of the serious discussants. This vignette has been drawn from a discussion during the Birth Tree dilemma unit taught by Irene:

Alois: *They* [the parents] *could have done it without Jack noticing…*
Irene (teacher): *How would you have felt about this if you were Jack and you would find out that your parents did something like that behind your back?*
Alois: *Kamikaze. I would cause a massacre, I would blow up the campervan ….this is the strategic counter attack!*
Irene (ignoring the last comment): *You are right, this is a question of strategy. Manuel what do you think about this?*
(No answer) Irene reprimands Manuel…
Irene (teacher): *You haven't listened Manuel – Alex can you summarise because Alex HAS listened carefully*
Alex gives a short description, gets really wound up whilst repeating Alois' comments and ends with: *…a massacre, HE SAID, he would commit a massacre!*
Irene (teacher): *Well this sounds really like a logical strategy.*
Manuel: *I think it is simply stupid!*
Susan adds: *Not quite normal…*

Whilst Alois continued to provoke, Alex contributed very good comments. I was not the only one who noticed Alex's changed behaviour. After the unit, Fatima mentioned to me that she was very surprised about Alex, *"Alex, he is not normally like that…so interested…I found this great!* (I-F2000). Alex himself supported Fatima's observation, *"I think it [teaching with dilemma stories] is very useful… because normally I never do any work because I am not interested but this I found very interesting and this why I engaged!"* (I-A2000).

It seems that the dilemma story approach, especially the discussion phase, provided an arena for Alex and Alois to participate in the discourse even though initially they might have had different agendas. Summarising, I can say that there seems to be another dilemma for curriculum planners and practitioners: dilemma units can be 'undermined' by disturbances of so-called 'problem students'. However, it appears that the dilemma story approach to teaching ethics can potentially get students on board who normally do not contribute positively to the classroom discourse. We might conclude that the dilemma approach can open up an avenue for those students to engage with and about science.

Dilemma 7: Time

Julian said, *"It was too long drawn out…"*(I-J2000), and I have to admit he was absolutely right. Given that the Ethics in Science Project was required to fit in

with the usual time-tabling, we 'squeezed' the dilemma unit into double-periods (of 100 minutes). Given that the teacher needs to plan for at least two hours class time for a dilemma unit containing up to three dilemma situations, the time limitations proved to be a major problem for the project. We could not complete the dilemma units in a single time period, and the lack of continuity was experienced as very disturbing by teachers, students, and me. Emma, one of Irene's students, complained that, *"We should have continued talking....it was pretty unsettling that the unit was interrupted so often. We would have needed more time, much more time in order to think ourselves back into it* [the dilemma story]" (I-E2000). The units were interrupted and continued on another day which meant that the memory of the last unit had to be refreshed before we could start any new activities, thereby losing more time. Emma added, *"Perhaps we should have taken the whole morning, enough time for everybody to get back into it..."* (I-E2000). This statement was also supported by Amanda. She said that she liked the story but, *"...I did not really like the interruptions and the distribution of the dilemma unit across several days"* (I-FG6A2000). Edward, on the other hand, found that the interruptions were not really a bad thing because, *"...like this you could engage with the topic for much longer and you could reflect about it"* (I-FG6A2000).

In this study, the two classes varied with regard to their time-requirements. Irene's multicultural class needed (much) more time than Sandra's so-called 'native' Austrian class. In Irene's class, I noticed many 'unsolicited' discussions at times when the students were actually required to work individually. The organisation of groups in Irene's class used up a lot of time which caused Irene to develop a sophisticated plan to organise the group-constellations. Sandra's class, on the other hand, was very task-oriented and followed instructions without delay. Some students, such as Julian, suggested that, *"I think* [we lost time] *with the story and also that we had to work out everything individually at first – I mean you have to do this anyway but within the group..."* (I-J2000). Daniela, on the other hand, pointed out that, *"I*

mean, it all depends strongly on the topic but, for example, for the topic 'violence' – this topic is so widespread – I would take much more time! (I-D2000).

I think Daniela's last point illustrates the dilemma with time very well: dilemma units take time - if a teacher still wants to use dilemma stories he/she needs to plan well in advance with regard to time-tabling, integration of other subjects, and with regard to the topic of the story, in order for the dilemma unit to work out. This requires much logistical effort which might scare teachers away from using this teaching method in their classrooms given that a lack of time is the prevalent problem for teachers in general. However, adapting the number of dilemma situations in a particular story might be a possibility for adjusting the units to the circumstances.

Summary and Implications

The results indicate that the use of dilemma stories as a tool for addressing controversial issues can challenge students' rational, social, and emotional skills, by engaging them in: practising identification with others, accepting other opinions, dealing with their own emotions and those of others. The study provides compelling evidence that dilemma teaching and learning can lead students to practise critical self-reflexivity about their personal values and beliefs, especially in relation to the nature of science. However, I have identified seven dilemmas potentially associated with teaching and learning using dilemma stories: the authenticity of students' comments, moral discourse, time and frequency, 'problem' students, teachers' skills, and the appropriateness of the stories. These dilemmas may open a forum for further discussion and further research, and provide clues on what to take into consideration when you intend to use dilemmas in a classroom.

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